Travelling salesman problem

...

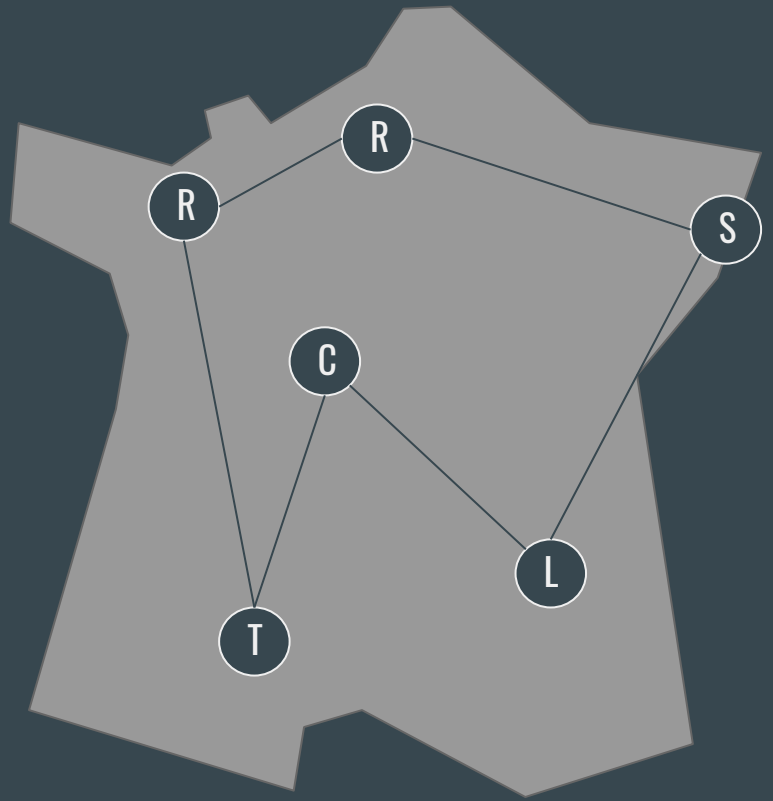
Pay attention, there is a 1M dollar prize if you solve it!

The problem

Find a tour of minimum length that visits every city only once !

⇔ Shortest **hamiltonian path**

1. Naive solution
2. Heuristic for greedy approach
3. Better idea
4. Polynomial solution



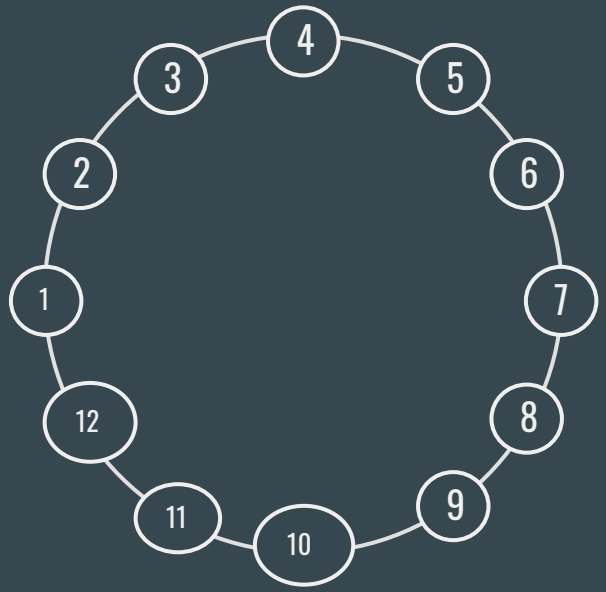
1. Naive solution : bruteforce

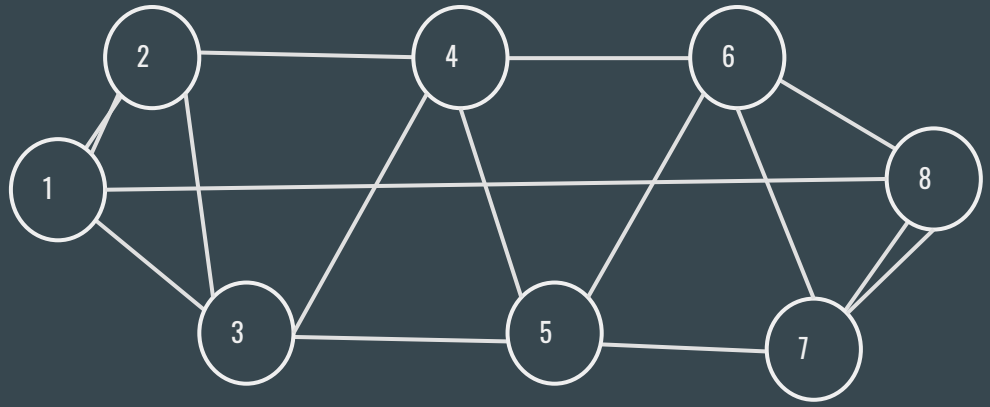
With N the number of nodes :

- Number of paths : n!
- Number of non redundant paths : (n-1)!/2

Limited to small instances of the problem (n < 12)

2. Heuristics : pick the closest as next





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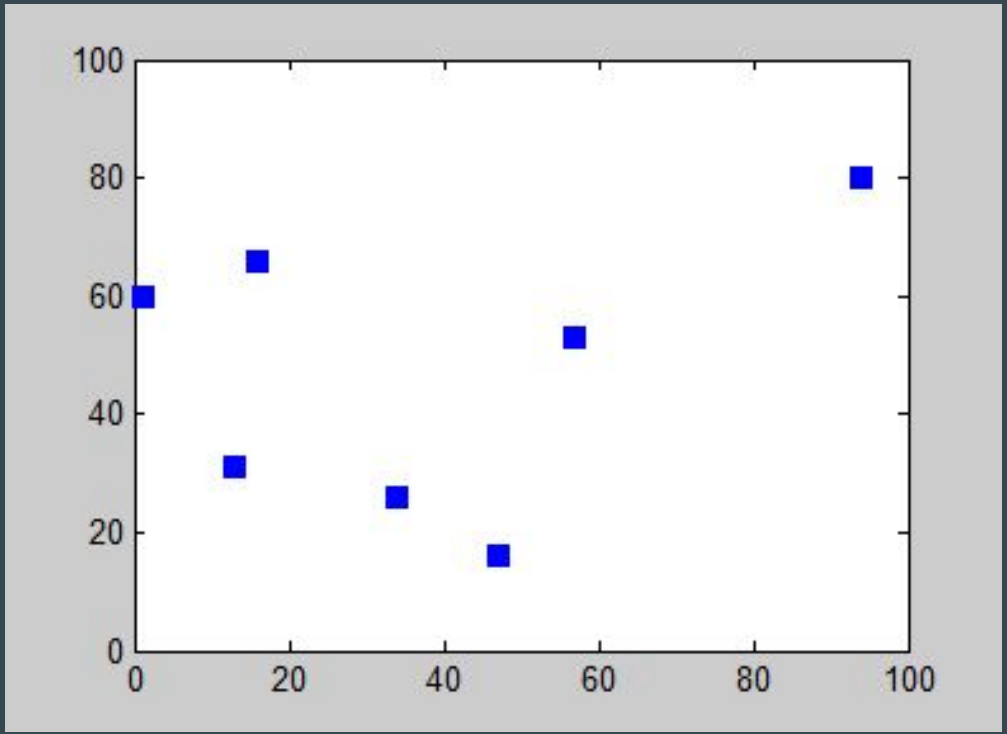
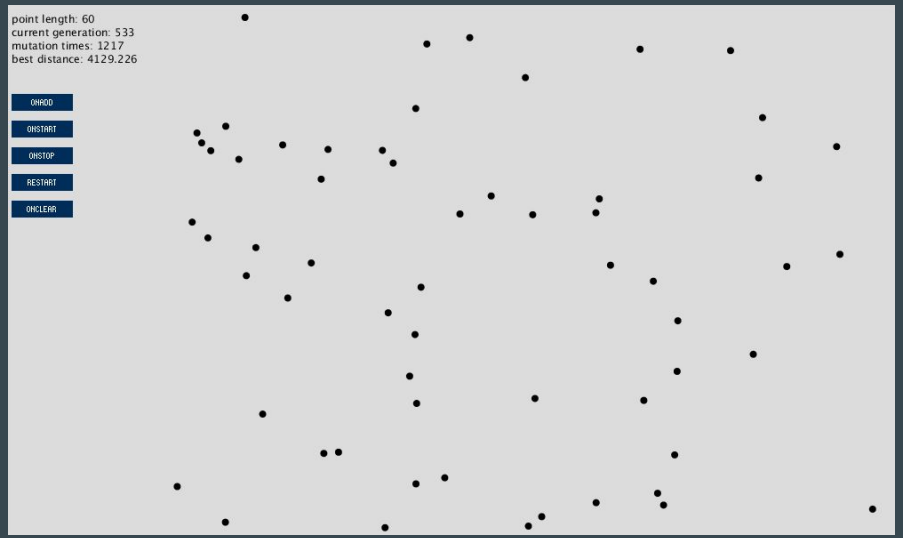


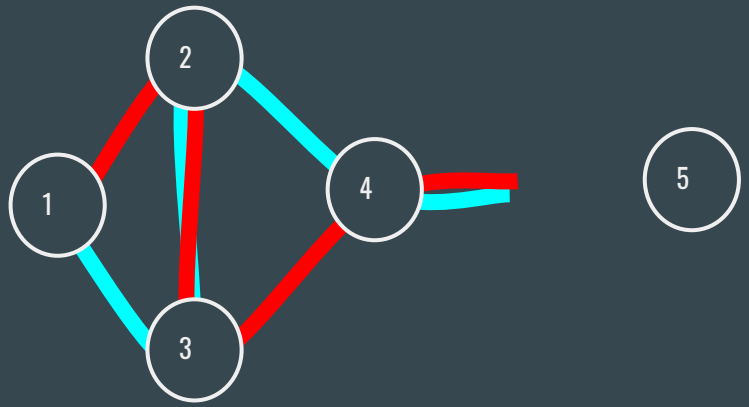
2. Heuristics : Genetic algorithm

- Generate a random population of paths
- Iterate introducing mutations and crossover



3. Exact solution : Dynamic programming

What is redundant in the bruteforce way?



{1,2,3,4}, 4

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3. Exact solution : Dynamic programming

A state is ..

- The set of nodes that have been explored
- The node we’re currently on
- The current distance from the source

3. Exact solution : Dynamic programming

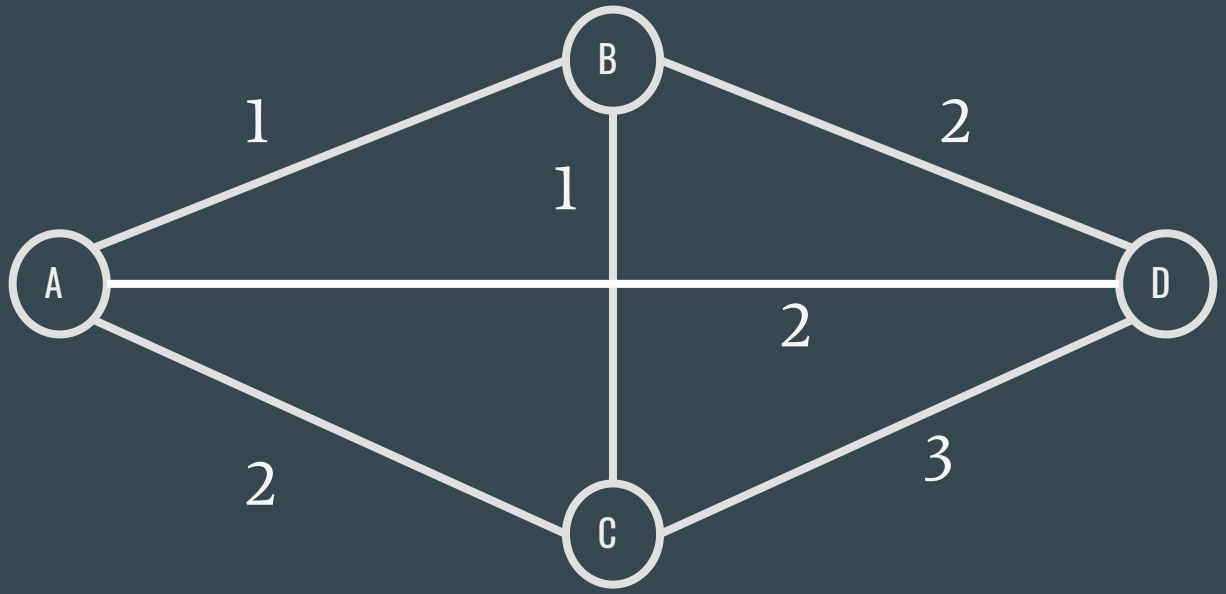
The Bellman equations...

$$dist(state)$$

$$=$$

$$\min(U(dist(state\_child) + distance(state,state\_child))$$

3. Exact solution : Dynamic programming



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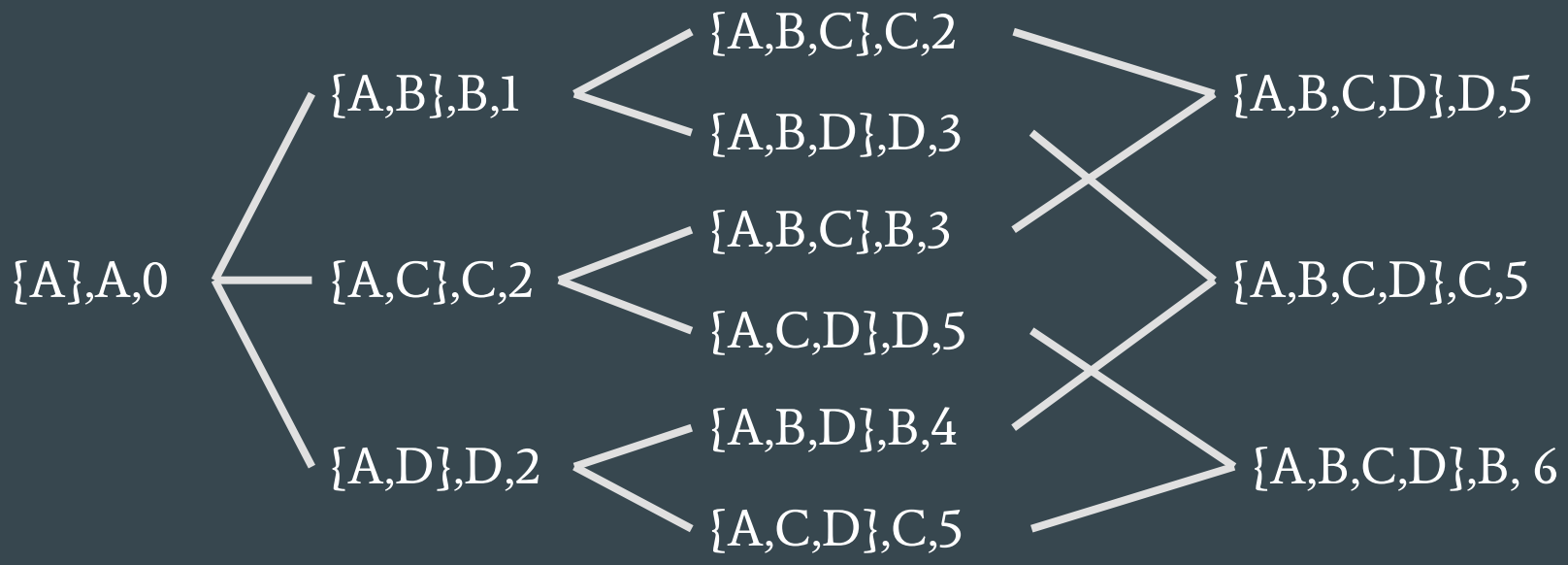

3. Exact solution : Dynamic programming

$$n^2 2^n$$

4. Polynomial solution